

# **SRI SIDDHARTHA ACADEMY OF HIGHER EDUCATION**

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**AGALKOTE, TUMKURU-572107**

**KARNATAKA**



## **Project Synopsis**

*On*

### **“GPS BASED TOLL COLLECTION SYSTEM”**

Submitted by

**REVANTHESH C** (20CS068)

**S KUSHAL** (20CS069)

**TUSHAR P RAJ TG** (20CS090)

**MITHUN GUPTA H M** (20CS121)

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**IN**

**COMPUTER SCIENCE AND ENGINEERING**

**Under the guidance of**

**DR.CHANNAKRISHNARAJU** B.E., M.S., Ph.D.,

**Professor, Dept of CSE,**

**Sri Siddhartha Institute of Technology**



**DEPARTMENT OF COMPUTER SCIENCE & ENGINEERING**  
**SRI SIDDHARTHA INSTITUTE OF TECHNOLOGY**

*(A Constituent College of Sri Siddhartha Academy of Higher Education)*

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## **ABSTRACT**

Developing countries like India needs a significant improvement in infrastructure such as Roads or Highways. Construction of these highways is a costly affair, which can't be invested by the government alone. Normally Public private partnerships are made to construct such a huge projects. The money spent on these projects can be regained by collecting toll from the passengers who use the roads. The toll collection system, especially in India faces some problems such as long queue lines, escaping from toll plazas etc. These systems can service only 300 vehicles per hour, and if more than that number of vehicles arrive at that plaza, server traffic jams may occur. To solve this we are proposing to create geo fences using GPS by giving latitude and longitude of the corner of the toll plaza. By comparing the position of the vehicle and toll plaza, the owner of the vehicle can be charged from the account.

Transportation has emerged as a dominant part of India. Toll plazas play a crucial role in maintaining the road transportation. At present, manual toll collection is most widely used collection method in India. It significantly requires a toll collector or attendant. Due to manual intervention, the processing time at toll plazas is highest. The project has been designed for the automation in toll tax payment using GPS and IOT Technology. Automation of toll plaza has been experimented using combination of Microcontroller, RFID, Global positioning system, Global system for Mobile. Implementation of automation in toll plaza enhances the monitoring of vehicles that are travelling in predestined routes. This project aims in designing a system, which automatically identifies the vehicle that advance towards the toll plazas and observes the vehicle number and the time of arrival. If matches exist between vehicle data and GPS data, then predetermined amount is automatically taken from the user account. It passes this information to avoid the Traffic congestion at toll plazas and helps in consuming less amount of fuel.

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## **I. Introduction**

Automation means to reduce the activities of human labour. This means the process handled by the humans will be carried out by the machines once it is programmed such a way that it reduces more amount of time and it decreases the possibility of risk factor. Overview of the toll booth system in late 90s is, around 90th century the toll plazas were controlled manually. Those system requires two people for opening and closing of the gate and another two are for reception of the money also data keeping etc. Later on, in the year of 1995 the development of Express Highway Systems introduced semi-automatic toll plazas were constructed in which data is stored in computers and operation of gate is automatic. Two persons are required for single toll plaza. Later on, the upcoming project aims in developing the human less toll plazas. The notable advantage of this technology is the opportunity to reduce the traffic congestion in toll plaza during festive seasons.

Electronic Toll Collection (ETC) is a fairly mature technology that allows electronic payment for motorways and expressways. An ETC system is capable to determine if a car is registered in a toll payment program, alerts enforcers of toll payment violations, and debits the participating account. ETC is fast becoming a globally accepted method of toll collection, a trend greatly aided by the growth of interoperable ETC technologies. All new electronic toll collection systems brought into service on or after 1 January 2007 shall, for carrying out electronic toll transactions, use one or more of the following technologies: satellite positioning, mobile communications using the IOT-GPRS standard (reference IOT TS 03.60/23.060) and 5,8 GHz microwave technology. The above mentioned conditions are included in the Directive 2004/52/EC of the European Parliament and of the Council of 29 April 2004 on the interoperability of electronic road toll systems in the Community [1]. The requirements of that directive will be implemented in Poland based on the Act from 7 of November 2008 and some other acts [2]. It stressed that toll collecting charge institutions should be able to carry out electronic toll transactions from 1 of July 2011. New electronic toll systems brought into service after the adoption of this Directive should use the satellite positioning and mobile communications technologies. The Working Group No 1 (WG1) of Technical Committee 278 (Road Transport and Traffic Telematics) established in 1991 is responsible for electronic toll collection systems in European Union. ISO/TC 204 is the partner of CEN/TC 278 in ISO, responsible for the international standardisation of transport information, communication and control systems. It is recommended to implement National

Automated Toll System for highways and expressways in Poland. Authors have carried out the analysis of some systems functioning all over the world to choose the best one for Poland.

A high security number plate is an aluminium-made number plate that is fixed onto a vehicle by a minimum of two non-reusable snap-on locks and has various identifiable features. On the top left corner of an HSRP, there is a blue-coloured chromium-based hologram of the size 20mm x 20mm of Ashoka Chakra. On the bottom left corner, there is a unique laser-branded 10-digit permanent identification number (PIN). Moreover, the numerals and alphabets of the registration number, have a hot-stamped film applied over them and are preceded by a blue 'IND' acronym. An HSRP is only issued after the digital registration of the vehicle and is linked to the vehicle. As such, the plates cannot be used on a different car and should act as a deterrent to theft and any other kind of misuse of these plates.

## **II. Literature Survey**

<b>Sl No</b>	<b>Title of Paper</b>	<b>Author</b>	<b>Gaps</b>
1.	Automated toll collection system using GPS and GPRS	Sudheer Nagothu	Many vehicles, especially in developing countries, may not have GPS capabilities. This could lead to exclusion and difficulties in implementing a universal toll collection system.
2.	GPS-based highway toll collection system: Novel design and operation	Jin Yeong Tan	The paper does not address the scalability of the system, especially in scenarios of high traffic volume. Considerations for handling a large number of vehicles concurrently may be crucial for practical implementation.
3.	A systematic review of electronic toll collection systems	Md.Khorshadul Haque, Mahir Shahrier, Armana Sabiha Huq	Given the digital nature of ETC, the paper should delve into the measures taken to ensure data security and address privacy concerns. Safeguarding personal information and transaction data is critical.
4.	Automatic Toll Collection using Global Navigation Satellite System	Kamala L, Chandrika C N, Rajesh S M, Hema K	While the proposed system is described as a solution, the cost implications for implementing and maintaining the global satellite navigation-based toll collection system should be thoroughly discussed. Affordability for both users and implementing authorities is crucial.
5.	Automatic Number Plate Recognition (ANPR)	Goyal et al, Ajanthan et al	There may be instances of false positives or negatives, affecting the accuracy of identifying unregistered, stolen, or disqualified vehicles, as well as enforcing speed limits.

### **III. Existing System & Gaps Identified**

#### **Existing System :**

National Payments Corporation of India (NPCI) has developed the National Electronic Toll Collection (NETC) program to meet the electronic tolling requirements of the Indian market. It offers an interoperable nationwide toll payment solution including clearing house services for settlement and dispute management. Interoperability, as it applies to National Electronic Toll Collection (NETC) system, encompasses a common set of processes, business rules and technical specifications which enable a customer to use their FASTag as payment mode on any of the toll plazas irrespective of who has acquired the toll plaza.

FASTag is a device that employs Radio Frequency Identification (RFID) technology for making toll payments directly while the vehicle is in motion. FASTag (RFID Tag) is affixed on the windscreen of the vehicle and enables a customer to make the toll payments directly from the account which is linked to FASTag.

FASTag offers the convenience of cashless payment along with benefits like - savings on fuel and time as the customer does not has to stop at the toll plaza.

#### **Gaps Identified :**

RFID - during initial stages of implementation there were issues regarding RFID reader. Most of the time it was not working. Sometimes handheld devices also become faulty

Server availability - If the server fails, it will result in the failure of the automated electronic deduction system.

Unemployment - toll plazas had hired many people for deducting toll. They will become unemployed as there will no need for them.

Ownership issues - owner's registration and bank details will be linked to the FASTag account, so in case the owner sells the vehicle, it is not clear whether a new owner will be able to drive the car with the same FASTag or not.

Safety of card - as it comes in tag form, it may be stolen or lost easily. In such a situation one will need to notify the authority to block the FASTag account

Wrongly charged - there were many instances of charging the double amount of the original amount due to some technical issues.

## **IV. Problem Statement**

FASTags are **prepaid rechargeable tags** for toll collection that allow **automatic payment deduction** from the FASTag, They are normally **affixed on the windscreen** of your vehicle.

With the help of a FASTag, you will **not have to stop your vehicle at toll plazas to pay the toll**.

As **soon as the vehicle crosses the toll plaza**, the toll fee will get deducted from the bank account/prepaid wallet linked to the FASTag affixed on the vehicle's windscreen.

An activated FASTag works **on Radio Frequency Identification (RFID) technology**.

Moreover, these FASTags **do not have any expiry date**, that is, they can be used **as long as they are readable** at the toll plaza and are not tampered.

All's not rosy with the new system, there are still inconsistencies, some readers don't function, the toll lanes are still clogged and the process is far too unpredictable.

The minister said that 93% of vehicles pay toll using FASTag but remaining 7% are yet to adopt it, despite paying double toll.

He said that he has instructed police inquiry for vehicles that are still not paying toll using FASTag

## **V. Proposed System**

The functional concept of a manual toll system is simple: the motorist takes a ticket at the entrance to the motorway and presents it at the tollbooth at the exit. Ticketing and toll barriers can also be placed on each section of motorway. With technological progress, these systems have evolved towards electronic toll collection, allowing traffic to flow more smoothly and improving service to both users and operators. System consists of Automatic Toll Collection Centre, control gates and on-board units. The system is based on an innovative combination of mobile telecommunications technology (IOT) and GPS, the satellite-based Global Positioning System. The main element of the automatic log-on system is the On-Board Unit (OBU). With the aid of GPS satellite signals and other positioning sensors, the OBU automatically determines how many kilo meters have already been driven on the toll route, calculates the toll based on the vehicle and toll rate information that has



been entered, and transmits this information to the ATCS computer centre for further processing. Software will be support with electronic road maps and data of users registered in as well as data charges of highways and expressways. Charge counting will be started after highway entrance gate and finished after highway exit gate. Data on vehicle position will be additionally approved by GPS system and delivered to ATCC by IOT net. The toll amount is based on the truck's emission category and number of axles, as well as on the length of the toll route. GPS placed in the toll system gives the location information to the user.

## **VI. Objectives**

1. **Efficiency**: Streamlining toll collection processes for faster and more convenient transactions.
2. **Accuracy**: Ensuring precise toll charges based on the actual distance traveled using GPS technology.
3. **Reduced Congestion**: Minimizing traffic congestion at toll booths through faster, automated transactions.
4. **Cost Savings**: Cutting operational costs by eliminating manual toll collection and reducing the need for physical infrastructure.
5. **Enhanced Security**: Providing a secure and traceable method for toll transactions, reducing the risk of fraud.
6. **Improved Revenue Collection**: Facilitating better revenue collection through accurate toll calculations and reduced instances of toll evasion.
7. **Real-time Monitoring**: Allowing authorities to monitor traffic patterns, assess road usage, and make informed decisions for infrastructure development.
8. **Environmental Impact**: Promoting environmental sustainability by reducing fuel consumption and emissions associated with idling at toll booths.
9. **User Convenience**: Offering a user-friendly experience with cashless, automated toll payments for commuters.
10. **Integration with Transportation Systems**: Enhancing overall transportation management by integrating toll collection data with other transportation systems for better planning and coordination.

## **VII. Model of Proposed Work**

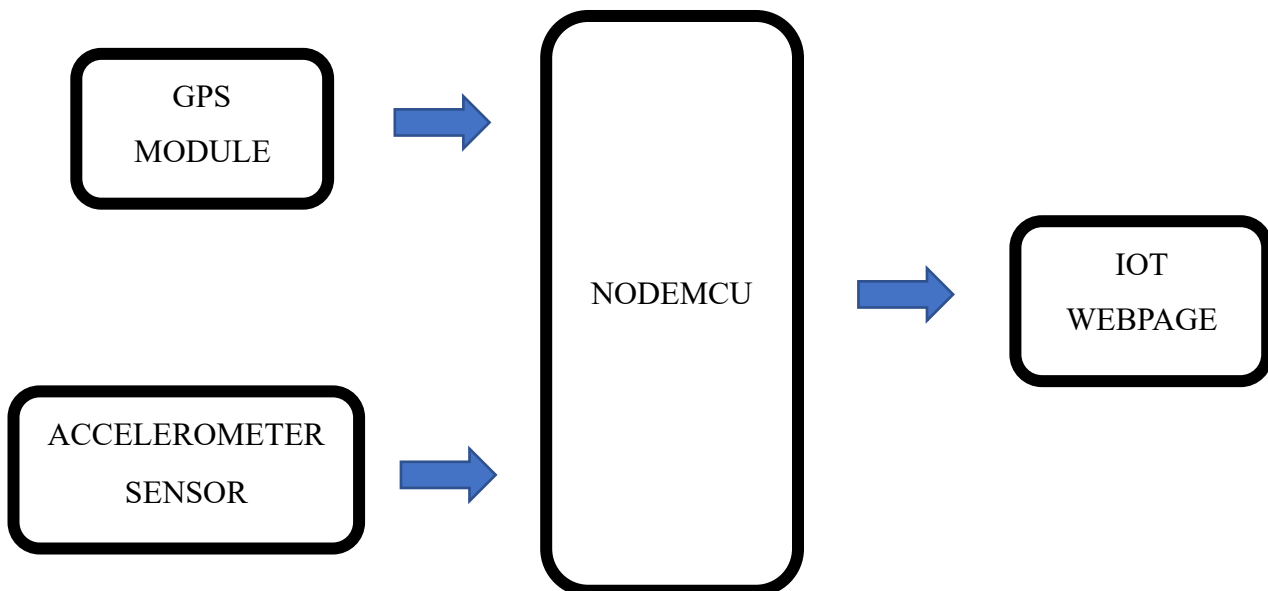
The new tolling system will bring about a free flow satellite-based ETC system that uses GPS and GPRS (General Packet Radio Service).

GPRS is already used to provide cellular-based data services by several telecommunication providers in India, and all commercial vehicles sold after 2019 are equipped with an inbuilt Vehicle Tracking System (VTS).

As such, the GPS-based system will further help make toll collection more efficient, by allowing vehicle movements across the country to be tracked accurately.

In India, the entire National Highway network will have to be geo-fenced for the GPS-based ETC to effectively monitor the entry and exit of vehicles.

Meanwhile, India's own geo-positioning system NavIC has recently been found to offer even more accurate location data than GPS, giving it even more impetus for nationwide adoption.



**Fig: Represents the model project**

## **VIII. Hardware and Software Specifications**

### **Hardware Specification:**

1. NODEMCU
2. GPS MODULE
3. ACCELEROMETER
4. POWER CIRCUIT
5. BATTERY

### **Software Specifications:**

1. ARDUINO IDE
2. EMBEDDED C
3. HTML

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